IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Brief Survey of Solar Energy in India

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Abstract: In ancient times, when no fossil fuel, mineral oil and coal were available, energy sources were available at that time, in which solar energy used to spread very well towards India and the world. But later the small (KW) plants at the micro grid/local grid level and the large (MW) plants at the national/state grid level can produce the electricity. Had oil and coal not been found as minerals, solar energy/renewable technology would have been developed? But its development was started much later, through which scope for good environment, good business, development, livelihood etc. started coming Along with this, due to the old sources of energy, a lot of pollution was spreading in the environment, whose effect is clearly visible on birds, animals, humans, but due to solar energy, our environment is also looking safe, today we are protected And to save the ecosystem, it is very necessary to reduce on solar energy. Innovations in low voltage power generation, mini grid/micro grid/local grid interaction and proper channelization of power system concepts are desirable aspects for the future. Life expectancy for today. In this paper, emphasis has been laid on achieving maximum growth.

Keyword: *Solar Energy*, *Renewable Energy*, Photovoltaic Cell, etc.

I.Introduction

In spite of the general economic crisis in India today, the energy consumption in India is increasing day by day, global warming is happening in the energy production, which is pointing towards the disastrous results. is increasing, the result of which can be fatal. Solar energy / renewable energy is such a source of energy through which it can be produced in abundance and can also be supplied. Our India is a country of villages and towns where It is necessary from the point of view of empowerment that power is an important issue for the people of this community to get the necessary services and for the improvement of their daily life. In today's environment, electricity is known as a basic facility, through which facilities for water, agriculture, education, enterprise etc. can be provided. Even today, there is no availability of electricity in some places in India, due to which a special community, living in energy poverty. Newly announced 19th EPS projects with a demand for electricity of 1743 TWh (6.59% CAGR) from 2017 and a peak load of 299 GW (6.32% CAGR) by 2027.

II. Solar Power Plant

The area of Almeria, Spain is home to the solar power project under consideration. The primary function of the solar plant, as shown by the appropriation of a collector field, is to collect solar energy by means of the heating of oil passing through the field [18]. Generally speaking, a solar cell is a little device from the modern age of electricity. To generate electricity on a larger scale, solar cells are first combined into a module consisting of many cells before being built into a PV array that may stretch for several meters in length (Deshmukh & Deshmukh et al. 2008). According to NREL's research, hundreds of solar arrays are networked together to establish a broader infrastructure for the widespread use of solar power in utilities [19]. The development of solar photovoltaics is practical, especially on a micro scale. The field is also equipped with a tracking system that allows the mirrors to spin along an axis perpendicular to the pipe, thereby allowing them to track the sun's changing tilt. A pump installed in the field inlet draws oil from the tank's base and sends it across the field. This heated liquid is then transferred to the storage tank, where it will be used in the production of electricity. [20]

Advantages of Solar power plant

- Solar energy is spotless and renewable energy source.
- Solar energy causes no pollution.
- Solar energy will keeps going perpetually while the world oil reserves are expected to keep going for 30 to40 years.
- Once a solar panelist installed, solar energy can be created free of charge.

OVER VIEW OF SOLAR POWER SYSTEM: Currently, worldwide climate change man ought to be a matter of interests for renewable energies particularly solar and wind. All renewable energies are distinctive types of solar energy, with the exception of geothermal and tidal. However renewable energy sources have a few issues related with continuity (IzgiErcan et al. 2012) [3]. The solar energy era which is a stand out amongst the most promising renewable energy era advancements can be used for meeting a decent percent of the entire world energy requests (Huvaetal.2012). With always expanding demands for energy and the significant body of proof that emission from conventional nonrenewable are connected to environmental change. Solar power is one of the energy sources with an all the most promising future: it can possibly supply the entire world's energy requests [4]. Photovoltaic is the most direct approach to change over solar aviation into power. Solar energy is not bales clean energy in light of the fact that there are no carbon emissions amid it sera (Mellette al. 2005). [5]

The expanding expenses of fossil fuels, instability of availability, expanding natural pollution and general mindfulness among the common citizens have lent to support the green sources of energy which incorporate solar photovoltaic, solar thermal, wind, biomass, little and huge hydro, tidal, wave ,ocean, and soon(Malaguetaetal.2005) [6].In the light of the discontinuity of solar energy, it should for the most part depend on other energy advancements to guarantee that end-user demand for power is dependably met. Hybrid frameworks, which consolidate solar thermal and other energy advances, have been initiated as an option to solar-only power era. For example, solar thermal power can be joined with conventional power era innovation to enable support to solar energy by demonstrated power era innovation like, gasandsteamturbines(Channon&Eames, 2014).[7]

Renewable energy is turning in to a vital and efficient source of energy for the power era. Important sources of renewable energy incorporate hydro, biomass, geothermal, solar, and wind. Specifically, throughout the most recent 30 years, solar energy exploitation has witnessed an extensive development [8]. A standout amongst the most essential favorable circumstancesofsolarenergyconcerningotherrenewableenergiesisthelikelihoodofutilizingcostproductivewarmthenergystockpilingframeworks.Theprospects for a higher proportion or 100% of world energy request to be met by renewable energy sources will depend fundamentally on the limits to solar thermal supply in winter and at not as much lesser as perfect latitudes (Ciroccoet al.2015). [9]

All renewable energies, with the exception of geothermal and tidal, originate from the sun. Solar energy, a son of the greatest prospective renewable energies, alludes for the most part to the utilization of solar energy in reasonable application. [10]This fantastic development in the utilization of renewable energy for power era and in light of a legitimate concern for keeping students' side by side of the present engineering developments and trends has kindled a trust in the fundamental and ability on renewable energy and power frameworks (Law et al. 2016). The term Hybrid Renewable Energy System (HRES) is utilized to depict any energy framework with more the none sort of generator normally a conventional generator controlled by diesel, and are new able energy source, like, Photovoltaic, wind, and Photovoltaic/wind. [11]

Day by day worldwide solar radiation information is viewed as, the most essential factor. In meteorology ,solar transformation, and renewable energy, especially for the sizing find visual Photovoltaic(PV) frameworks (Forresteretal.2014) [12].PV frameworks offer an option to conventional era frameworks for lower power applications in detached regions and, in zones close to power systems, can be effectively associated with medium and lower voltages grids [13]. The greatest power from PV modules differs in the reliance one ecological components, like, insulation and cell temperature. PV changes over light into electric current utilizing the photoelectric impact and delivers considerable waste warmth, which can be recouped for the ramous by connecting PV board with recovering tubes loaded with transporter liquids. A solar cell is, by and large, a little power era gadget. Keeping in mind the end goal to create power at a bigger scale, solar cells are consolidated to

frame a unit of numerous cells, these units are then collected into a PV array containing the length up to a few meters (Powell etal.2014). [14]

CSP plant with thermal stockpiling offers the capability of large-scale, dispatch able power produced from daylight. A vital component of them arket viability of CSP is the decision on its value to the grid (Mehos et al.2015) [15]. Difficulties in appropriate valuation of CSP incorporate the entangled way of this innovation. Dissimilar to totally dispatch able fossil sources, CSP is a constrained energy asset that depends upon the hourly and day by day supply of solar energy. A CST plant can store overabundant warm energy into Thermal Energy Storage (TES) (Vasallo&Bravoetal.2016).Which has many structures and commonly comprise two tanks of a molten salt–one hot(charged) and the other cold (released). [16] For the advancement valuation of CS Advances, this report reviews on the cost-effective and unwavering quality advantages of CS Pwiththermal energy's to ck piling, including though to framework combination costs acquired by other renewable assets (Denholm etal. 2014,Sinha & Chandel, 2015). CSP frameworks utilize lenses or mirrors and following frameworks to warm a liquid, like, water in a boiler to create steam used to deliver control in a steam turbine tied to an electrical generator. [17]

Solar thermal energy with storage energy system: Power is generated at Sun Thermal Power Plants (STPP) by focusing solar beam segments onto receivers, where the resulting heat changes the course of a thermodynamic cycle (Kost et al. 2013). STPPs equipped with a capacity energy framework may function similarly to conventional power plants while also competing in the energy stock market and avoiding power generation interruptions [21]. As the price of energy production has decreased, the warm storage system has been exploited to its maximum capacity. Stockpiling heat energy has several benefits, including,

- **Profit maximization**

The Profit maximization in times of energy stock market means low costs, storage warm is conceivable, and when costs are high, the plant can keep running at full ability even without approaching solar energy. [22]

- **Reducing intermittence**

The generation of power can be steady without changes. Thus ,STPPs can work in the electric grid in a manner similar to a conventional power plant analogous to the segments like the turbines endure lesser because of the lessening of association sand disassociations. [23]

- **Increasing plant utilization**

The general yearly generation can be expanded. In times of higher approaching solar energy, the overabundant of warm energy can be utilized as when warmth from the solar field is insufficient to move a turbine to it nominal power.

➢ **Peak saving**

The power national utilization peak a mid late morning can be decreased without relying on different sources of energy.

1.2.4 Photovoltaic Cell

Solar energy may be turned directly into electrical energy via the PV effect, which is the key underlying principal mechanism involved. PV systems not only take use of the sun's abundance, but they are also easy to set up, need practically little upkeep, and are environmentally friendly (Cau&Cocco 2014). Maximizing your PV system's efficiency using a tracker may help you save money and cut down on energy waste (MPPT) [24]. Conventional MPPT involves monitoring the PV array's current and voltage to determine the power output and then adjusting the converter's duty cycle to match the maximum power point. PV-based control generation makes use of solar panels, which may be made from a broad range of photovoltaic materials. Several SC methods are gaining traction as potential solutions to this issue [25]. These methods include artificial neural networks, fuzzy logic controllers, genetic algorithms, differential evolution, and particle swarm optimization. Recent efforts have focused on implementing a novel SC technique known as Cuckoo Search.

The sun provides the energy necessary to run a PV system, and this source is quantified by measurements of both its overall intensity and its distribution along an inclined plane. The term "solar photovoltaic" (PV) refers to the process through which energy from the sun is transformed into electricity (Pedro & Coimbra 2012). The creation of a model of the PV module is important for research into the most effective method of implementing a PV framework [26]. Photovoltaic cells have found use in many different fields, such as agriculture, industry, telecommunications, public services, healthcare, and private residences.

Generation of Photovoltaic Technology: The history of PV development may be roughly divided into three periods: the first, the second, and the third. Because of the wide variety of semi-conductor materials used, the overall efficiency and performance of these PV technologies vary greatly [27]. The first two generations of photovoltaic's (PV) have undergone commercial development and produced substantial scale production, while the third generation is still in its infancy and research and development stages.

CONCENTRATING SOLAR POWER PLANTS: In 1979, Sandia National Laboratory installed the first commercial CSP plant in New Mexico. The United States and Spain, two of the countries that have invested the most in research and development for concentrated solar power (CSP) facilities, now account for the great majority of the world's installed electric power using this technology (515 and 1002 MWe individually). More than 700 MW of CS limitations were implemented worldwide between April of 2010 and March of 2012 [28]. Over twenty thousand megawatts (MW) of solar thermal electricity have been created so far. Impacts on CSP designs in 2013 and 2020 in terms of thermal energy storage capacity and solar field size are shown (Gallego &

Camacho 2012). This spectacular spread of renewable energy is anticipated to soon be implemented in additional power frameworks throughout the world, which is sparking renewed interest in concentrated solar power (CSP) with warm energy storing. [29]

Compared to the fossil fuel age, traditional wind and solar facilities must reduce their contributions to asset sufficiency in order to distribute electricity on a variable basis. Currently, concentrated solar power (CSP) facilities are operational in three different states: solar field, the power block, and the TES framework [30]. The system also includes modules that focus on solar collector fields, store thermal energy, and generate electrical power (Zhu et al. 2014). Based on these four steps, the most important characteristics of CSP-based solar power facilities are outlined below. [31]

- High efficiencies can be accomplished in the light of use of thermodynamic cycle with high temperature input through CSP innovation.
- CSP innovation utilizes just the immediate part of approaching solar radiation. However it incurs the loss of the diffused and reflected segments.
- CSP innovation need higher estimation of Direct Normal Irradiation (DNI).
- Due to higher principal cost, CSP innovation is not appropriate for little scale solar power plants.

Concentrating Solar Collectors: An energy collector uses solar radiation to create heat energy that may be converted into electricity. One of the primary functions of a solar collector is to absorb heat from the sun's rays and transfer that heat to a Heat Transfer Fluid (HTF) that circulates inside the collector itself (Khan & Arsalan 2016) [31]. The solar collectors are linked to the power generation system through the warmth exchange liquid, which transfers heat from each collector to a central steam generator or heat storage system as it flows. Two distinct types of solar collectors have been identified: fixed, non-concentrating collectors and sun-tracking, concentrating collectors [32].

1. Stationary non concentrating solar collectors

The stationary non-concentrating solar collector is the execution of a similar range utilized for both block interception and absorption of incidental dilation.

2. Sun tracking concentrating solar collectors

Concentrating solar collectors that track the sun throughout the day use optical components to focus a large amount of energy onto a small receiving range and move with the sun throughout the day to maintain maximum solar flux. [33]

Parabolic trough, linear Fresnel, central-receiver, and dish/engine are the standard four types of CSP developments.

Parabolic Trough Collector: PTC technology is the most advanced and widely used as a result. Warm oil input and output temperatures are designed to be comparable for both parabola trough and linear Fresnel collectors (Martin et al. 2010). Sunlight heats an exchange fluid, often oil, in solar troughs [34]. As the HTF travels across the solar field, it absorbs the sun's rays and converts them into usable heat. Figure 1.1 displays the parabolic through collector.

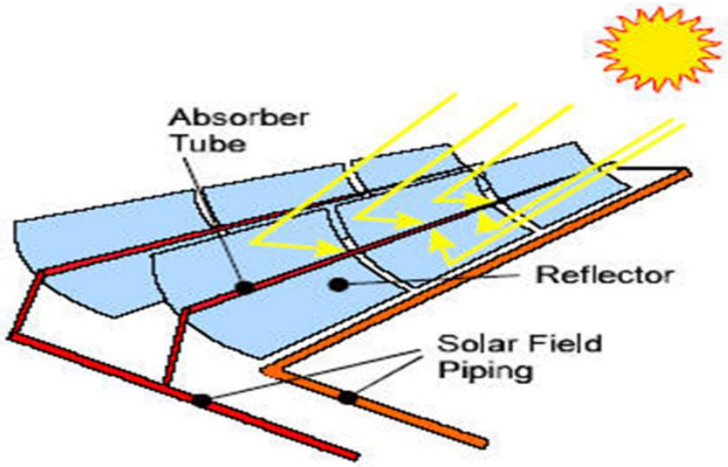


Figure 1 Parabolic trough collector

The heated liquid is then used to generate steam, which turns a turbine and ultimately provides the required electricity to the grid (Camacho et al. 2012). [35] Since the primary energy source, solar energy, cannot be regulated, the oil stream q is used as a control signal to maintain the field's outlet temperature as near as possible to a set-point (Fernandez-Garcia et al. 2010). Presently, 90% of CSP power facilities across the globe use parabolic-trough gatherers, making this technology the dominant player in the CSP space. [36]

There are three main components to a parabolic trough power plant with heat storage: the solar field equipped with a heat exchange circuit, a heat storage system, and a power block consisting of a turbine, a generator, and a cooling system (Padilla et al. 2011). [37] This technology use a curved mirror array to concentrate the sun's rays onto a high heated execution permeable pipe lined up in the middle of the concentrators' row, through which liquid flows to facilitate heat transfer [38]. Mineral oil is often used to transport the stored solar heat via a network of pipelines and into a power plant. Here, heat is transferred to steam and sent via a heat exchanger and turbine to generate electricity.

Moving via the receiver, the HTF collects thermal energy and sends it either to power generation structures (usually a boiler and turbine generator) or to storage facilities (Gallego et al. 2013). PTC architectures often employ water or oil as the HTF, with the latter being the preferred option due to its higher boiling point and

considerably reduced instability. Thomas has suggested a few basic designs for water boilers. [39]

Linear Fresnel Collectors: Technical literature suggests that, contrary to expectations, linear Fresnel collectors achieve lower efficiency than parabolic trough collectors when comparing annual execution (Santos-Alamillos et al. 2015). The shape of a linear Fresnel collector may shift depending on the size and placement of the mirrors it contains [40]. To offset this optical disadvantage, the linear Fresnel collector often requires fewer and cheaper collector pieces (Santoso & Mack Grady 2005). Linear Fresnel collectors look to be becoming a desirable alternative to parabolic trough plants for harnessing solar energy. The linear Fresnel advancement is a more refined version of the parabolic trough, with the added benefit of using flat mirrors, which are much cheaper than parabolic reflectors. More reflectors may be installed and put to use in small facilities [41]. The implementation of the linear Fresnel collectors is seen and described in Figure 1.2.

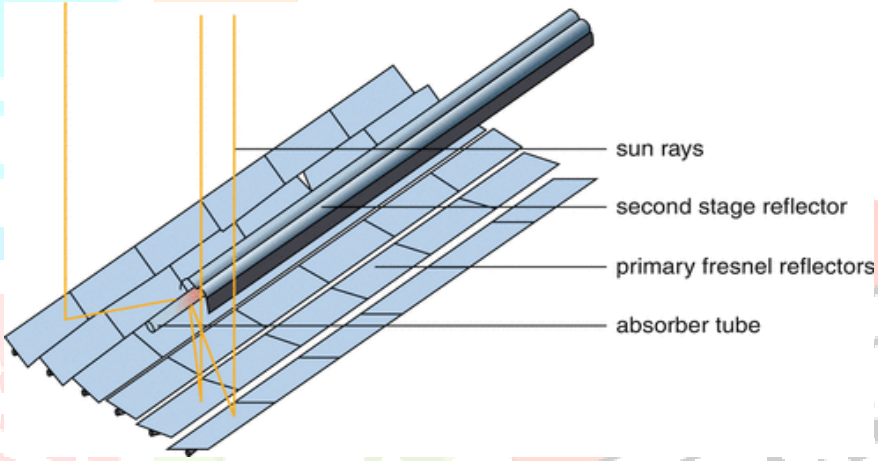


Figure 2 Linear Fresnel Collectors

Light from a linear Fresnel reflector is focused onto a direct receiver by fusing a lengthy array of flat mirrors. The receiver is mounted on top of a tower (typically between 10 and 15 meters in height) with reflector arrays extending out from its base. The flat, flexible nature of the mirrors used makes the Linear Fresnel reflectors outline fundamentally cheaper than PTC [42]. The mirrors may be placed on one or two axes using the components specified below. The light between adjacent reflectors is a significant challenge for systems using Linear Fresnel reflectors. Expanded dispersal among mirrors requires either more area for installation or taller receiver towers, both of which contribute to the expense of a solution. Linear Fresnel collectors have a number of benefits, including its ease of use, durability, and relatively little initial investment.

Central Receiver Systems: The innovation relating to solar power towers is economically at lesser advanced stage than linear parabolic trough collectors. Regardless of this, various test locations have been tried on the field in a variety of sites scattered in various locations throughout the world in the most recent 15years. [43]

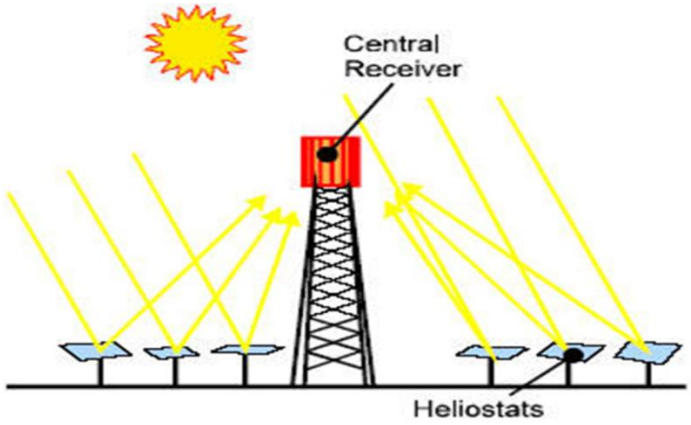
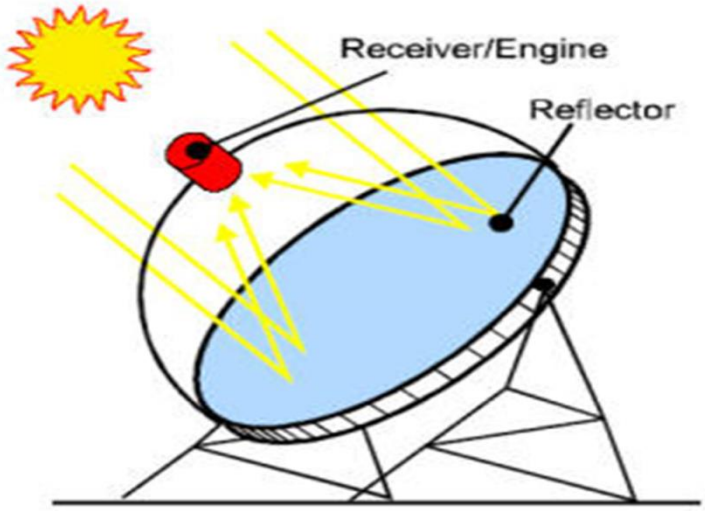


Figure 3 Central receiver systems

The heliostats in the central receiving frames follow the sun independently; reflecting its rays to a receiver perched atop a tall tower (Usaola 2012). A steam turbine uses the heat to generate electricity when it's required. The heat from the receiver is transferred through a liquid to a steam generator, which in turn powers a turbine [44]. While steam/water, molten salts/fluid sodium, or air may all serve as heat exchange media, the use of gas or compressed air allows for far higher temperatures to be reached, resulting in significantly greater efficiency. As seen in the accompanying Figure 1.3, the central receiver architecture is shown to operate as follows.

In this case, the capacity framework can ensure that all available solar power is used effectively. It's possible that thermal solar-oriented facilities' output of energy is not restricted just by the number of hours during which the sun is shining and by the presence or absence of clouds [45]. The liquid, such as molten salts, may be heated by the central receiver and used as a source of energy storage.

Parabolic Dish Engine: Small-scale paraboloidal dish concentrators typically consist of a reflector and a motor generator mounted at its focal point. The sterling engine or gas turbine that produces 5 to 25 kW of power is the



foundation for the motor generator unit's operation. In this case, hydrogen or helium heated to 750 degrees Fahrenheit is used as operating for the sterling engine, with the goal of using solar operations for base load by means of thermal energy storage and expanded collector fields. [46]

Figure 4 Parabolic dish engine

The sterling engine converts the sun's thermal energy into mechanical energy, which is then transformed into electrical energy by a generator connected to the engine (Sioshansi& Denholm 2010). The concentrator is installed on a two-axis following structure that allows for vertical and horizontal adjustment to ensure it is perfectly oriented towards the sun for maximum efficiency [47]. A sensor that tracks the sun's movement or special software that continuously and rapidly determines the position of the sun controls the orientation of the system. The investigated parabolic dish engine is seen in Figure 1.4.

III. Conclusion

Through the presented research paper, it is being shown that at present solar energy should be made a medium of electricity generation so that electricity can be available to all classes and it should be necessary for the government to formulate such policies so that it becomes the business of the people. It can be made and every person can produce electricity and use it as well. People also need to understand that today they should produce and use solar energy so that they can be able to build the nation. Adaptation, electricity in the form of hybrid energy. It is necessary to model a power system that includes photovoltaic arrays, battery banks and combined heat and power systems with micro grid tools to deploy off-grid residential solutions that can be combined to meet load demands in Indian rural Can be combined with fossil fuel, biomass, biomass gas based small scale CHP system. Small scale CHP system can be added in the area of cogeneration to get electricity, so that solar

system, PV system, space heating and cooling water heating etc. can be used. There should be power management system, which can reduce the disturbances caused by Micro grids do not have to be faced to suppress and suppress; such grids integrate electricity in solar energy / renewable energy so that electricity can be transmitted in equal quantity. Software algorithms should be designed and suggested to overcome the adverse effects of lightning events.

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